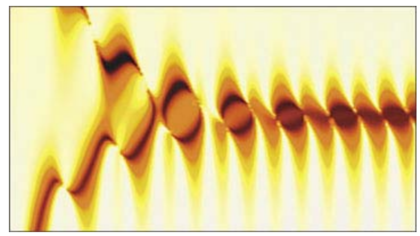
Unusually strong optical interactions between particles in a waveguide

J.J. Sáenz(1) and R. Gómez-Medina(2)
(1) "Moving Light and Electrons" Group, Dept. Física de la Materia Condensada, Universidad Autónoma de Madrid, 28049-Madrid, Spain.
(2) Donostia Internacional Physics Center (DIPC), 20018 San Sebastián, Spain

Intense optical fields can induce significant forces "*between*" particles [1,2]. In absence of absorbing or "Mie"-like resonances, light forces on atoms, molecules, and nanometer-sized particles are, in general, very small. However, when the fields are confined in quasi-one-dimensional (Q1D) waveguide structures, geometric resonant modes can lead to unusual strong optical interactions "*between*" particles [3].

In the presence of two particles, there is a non-trivial splitting of the geometric resonance which does not always correspond to the expected familiar bonding-antibonding picture of atomic physics [2]. We show that, under the presence of two counter-propagating (non-correlated) modes, the effective interaction potential can be tuned to induce a stable optically bound dimer [3].



Contour plot, in frequency-distance space, of the calculated optical force on a two-particle system inside a waveguide. [Cover page, Phys. Rev. Lett. **93** No 24 (2004)]

[1] M. M. Burns, J.-M. Fournier and J. A. Golovchenko, Science **249**, 749 (1990).
[2] M. I. Antonoyiannakis and J. B. Pendry, Phys. Rev. B. **60**, 2363 (1999).
[3] R. Gómez-Medina *et al.*, Phys. Rev. Lett. **86**, 4275 (2001); **93,** 243602 (2004).